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An Analysis of Alternative Requisition Cycle Lengths

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14. ABSTRACT

The objective of this study is to analyze the potential impacts of implementing alternative requisition cycle lengths in enlisted distribution. The analysis in this paper is based on solving 288 optimization problems using the Assignment Policy Management System (APMS) to test three different durations of the requisition cycle (i.e., 1-month, 2-month, & 3-month). The simulation uses Navy personnel and requisition data, which spans a 9-month period from April 2002 to December 2002 and records results for six Navy metrics, or measures of effectiveness (MOEs). The analysis showed that certain MOEs, such as Permanent Change of Station (PCS) costs, Navy Enlisted Classification (NEC) reutilization, and number of assignments made were substantially improved by extending the requisition cycle length. As expected, additional increases in requisition cycle length appear to decline as the requisition cycle length increases. Requisition cycle lengths longer than three months may generate only modest additional benefits. The conclusion from the research is that the Navy should consider extending the requisition cycle and changing from a sequential to a batch approach in making enlisted assignments.

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Foreword

This report summarizes analyses of alternative Enlisted requisition cycle-lengths conducted in support of the Distribution Incentive System (DIS), a 6.3 research project funded by the Office of Naval Research under the Future Naval Capabilities, Enabling Capability, called Acquire. “Requisition cycle-length” refers to the frequency with which jobs and Sailors are matched to determine subsequent assignments. Historically these cycles have been kept short (two-weeks) so that the problem was tractable for decision makers (called Detailers). If more jobs and Sailors are considered simultaneously there is more opportunity to satisfy by Navy and Sailor desires. If the cycle length is increased, more jobs and Sailors will be in the pool, and on average, better Sailor-job matches can be made, from both the Navy’s and Sailor’s perspectives. This report is an empirical demonstration of this phenomenon and makes a strong case for extending the cycle length. More importantly, the paper also makes a strong case for adopting the use of multi-objective mathematical optimization to make future Sailor-job matches.

The authors wish to thank the functional sponsors for the Distribution Incentive System, CAPT Roy Harkins, and his successor CAPT Stephen McShane, for their support, leadership, and guidance.

DAVID L. ALDERTON, Ph.D.
Director

Executive Summary

Background

Every year approximately one third of the Navy's enlisted Sailors are reassigned to new jobs. To determine which jobs will become available the Navy forecasts the type of jobs it will likely need in nine-months. These projections (referred to as requisitions) are based on manpower needs but also reflect the skills of the Sailors that are up for reassignment in nine months. Those Sailors are referred to as the Sailor inventory. The projected vacancies are updated and filled in one-month cycles. Every month the Enlisted distribution system produces thousands of jobs, "scrubs" them to ensure that the Navy requirements are represented accurately in the jobs that are presented to Sailors for application, and attempts to match job requirements with Sailor qualifications.

Problem

Experience suggests two main problems afflict the current one-month cycle and sequential approach to assignment. First, the detailer often has trouble matching Sailors' skills to job requirements due to budgetary constraints and limited inventory. This problem is compounded by the fact that assignments are made with limited decision support tools that do not optimize assignments to identify the best possible set of assignments. Instead, detailers, who determine the assignments, generally take one job at a time and select the best Sailor. Compared to an optimization-based approach that considers all possible sets of assignments simultaneously, this sequential approach often yields suboptimal sets of assignments. The second problem is that instead of seeing all of their career options at once, Sailors see a limited series of jobs. This restricted view often forces them to either settle for an available, albeit imperfect job or gamble that the next set of available jobs will be better. After three cycles, the Sailor will be assigned to an open job whether he finds it desirable or not. If larger groups of jobs could be shown to the Sailor at once, there would be a greater chance of satisfying the Sailors' preferences and achieving the Navy's goals in terms of quality skill matches.

From a mathematical point of view, both the Navy and individual Sailors could be more satisfied with the assignment process if the job cycle were extended beyond one month. Given the business rules and practices currently followed in today's Enlisted distribution system, reasons planners cite for not extending the job cycle are valid. However, many ideas currently being considered by Navy leadership could transform the Enlisted distribution process so that confidently producing extended projections and executing the accompanying assignments would be quite feasible. It is worth noting that it is in part this logic that has compelled the Navy to extend its job cycles from two weeks to one month.

Objective and Approach

The objective of this study is to analyze the potential impacts of extending the enlisted job cycle lengths beyond the current monthly period. The analysis in this paper follows from the solutions generated by 288 optimization problems using the Assignment Policy Management System (APMS) that tests three different job cycle lengths (i.e., one month, two months, and three months). The simulation uses Navy personnel and job data that span a nine-month period from April 2002 to December 2002 and records the results for six Navy measures of effectiveness (MOEs). Since only a subset of all Navy jobs are used (i.e. one deskcode), the results are not intended to be definitive, but they do serve to highlight likely effects of changes in job cycle length.

Conclusions and Recommendations

Analysis shows that certain MOEs, such as Permanent Change of Station (PCS) costs, Navy Enlisted Classification (NEC) reutilization, and number of assignments made, were substantially improved by extending the job cycle. The direct conclusion from this research is that the Navy should consider extending the job cycle. To facilitate implementation of this recommendation requires that the Navy extend the Sailor inventory projection/job projection to 11 months and change from a sequential to a batch approach to making Enlisted assignments. Supporting recommendations are outlined in the Conclusions and Recommendations section. See the Glossary in the Appendix for acronyms.

Contents

List of Tables

Overview

Introduction

Every year approximately one-third of the Navy's enlisted Sailors are reassigned to new jobs. To determine which jobs will become available the Navy forecasts the type of jobs it will likely need in nine months. These projections (referred to as requisitions) are based not only on its manpower needs but also reflect the skills of the Sailors who are up for reassignment in nine months. Those Sailors are referred to as the Sailor inventory. The projected vacancies are updated and filled in 1-month cycles: every month the Enlisted distribution system produces thousands of jobs, "scrubs" them to ensure that the Navy requirements are represented accurately in the jobs that are presented to Sailors for application, and attempts to match job requirements with Sailor qualifications. This latter procedure, matching Sailors to jobs, is known as the assignment process, and is performed by "detailers" in a sequential manner, based on Sailor input and detailers' subject matter expertise.

Problem

The problems with the current 9-month projection and sequential approach to assignment are manifold, but experience suggests two main problems. The first is that the detailer often has trouble matching Sailors' skills to job requirements due to budgetary constraints and limited inventory, compounded by the sequential nature of the assignment process. The second problem follows from the fact that instead of seeing all of their current career options at once, Sailors see a limited series of job listings. If the perfect job appears and the Sailor is selected for it, then the optimal outcome, from the Sailor's perspective, has been achieved. More often; however, the perfect job does not appear and the Sailor must decide whether to settle for a less than perfect job or pass it up in hopes that in the next cycle a better job will appear and that he will be selected for it. At the same, if he waits, there is no guarantee that even the less-than-perfect job will still be available. Thus, the Navy's inability to forecast out beyond the nine months required for the current 1-month cycle potentially reduces the quality of the fit of Sailor to job matches. This is true from the Sailor's perspective because it makes the process more personally conflicting than it would be if he could see all jobs available to him at once. It is also true from the Navy's perspective since better skill matches are likely possible with a greater pool of jobs and applicants.

From a mathematical point of view, both the Navy and individual Sailors could be more satisfied with the assignment process if the job cycle were extended beyond one month. The problem with extending the cycle in the current business process is that one either has to compress the detailing window (less time from the moment the Sailor knows where he is going until he must report for duty) or project the manpower requirements beyond nine months. The former imposes greater uncertainty and planning burdens on the Sailor and the Navy. The latter option, extending the manpower projections beyond the current 9-month projections, is difficult because confidence in projection accuracy decreases substantially as the time frame increases. This uncertainty is directly related to the factors affecting the Enlisted distribution system's demand signals: advancement cycles[1], misalignment of PRD-EAOS (planned rotation date-end of active obligated service)[2], separations, and billet funding changes.

The current system is segmented into 12 pieces in part to make the detailer's job more manageable. If the projection were extended and larger groups of Sailors and jobs were considered, the number of assignments each detailer is responsible for simultaneously making quickly becomes unmanageable. With only 10 Sailors and 10 jobs, there are over 3.6 million possible assignment combinations. Achieving an optimal outcome is far from guaranteed. Using a numerical optimization algorithm to generate recommend optimal slates can make it feasible to match even larger sets of Sailors and jobs and produce better outcomes. This paper illustrates the effectiveness of one such algorithm and the implications of its use on various lengths of detailing windows (i.e. 1-, 2-, or 3-month groupings of Sailors and jobs).

Purpose

Many ideas currently being considered by Navy leadership: aligning Sailors' PRDs with EAOSs (see endnote 2), 12-month advance detailer-Sailor career contact, Team Detailing, position management, and the drive to capitalize on advanced technology in the development of Navy personnel systems could radically transform the Enlisted distribution process such that confidently producing extended projections of inventory and jobs and executing the accompanying assignments would be quite feasible. The objective of this study is to analyze the potential impacts of implementing alternative job cycle lengths in the Enlisted distribution system, given the business rules to facilitate accurate projections beyond nine months.

Simulation Description

The analysis in this paper is based on solving 288 optimization problems using the Assignment Policy Management System (APMS) to test three different lengths of the job cycle (i.e., 1-month, 2-month, and 3-month). APMS is prototype optimization software that matches Enlisted Sailors to jobs according to specified metrics. Although the software was designed to perform sensitivity analysis among various metrics and policies, it was used in these simulations to compare only optimal values of specified metrics over alternative job cycle lengths. The simulation uses Navy personnel and job data, which spans a 9-month period from April 2002 to December 2002 and records results for six Navy measures of effectiveness (described in Table 1).

To enhance the efficiency of conducting the required tests, researchers developed an interface to APMS that allowed them to run many problems automatically. The interface uses WinBatch®, a scripting language designed to provide batch automation capabilities for Windows-based systems.

To meaningfully compare the overlapping 2-month and 3-month scenarios, a rolling horizon approach with a step of 1 month was used. For example, using the three 1-month problems APR, MAY, and JUN, two 2-month problems were formulated: APR-MAY and MAY-JUN, and one 3-month problem was created: APR-MAY-JUN. This approach produces nine 1-month problems, eight 2-month problems, and seven 3-month problems for any given period of nine months.

Table 1
APMS Navy Measures of Effectiveness (MOEs) used

MOE No.	MOE	Description	Type of Optimization
1	Number of Assignments	Measures the number of assignments made between Sailors and jobs in a given run	Maximize
2	Navy Enlisted Classification (NEC)[3] Reutilization	Measures the percentage of assigned Sailors whose existing NECs are required by the job to which they are matched	Maximize
3	PCS Cost	The average Permanent Change of Station (PCS) cost the Navy must pay over the assignments made	Minimize
4	Gap/Overlap	The average number of months that Sailors are assigned early (overlap) or late (gap)	Minimize
5	On-time Arrival	Measures the percentage of persons with an Estimated Date of Arrival (EDA) that matches the Take-Up Month (TUM) of the job	Maximize
6	Paygrade Match	Measures the percentage of assignments where the Sailor's paygrade matches the job's paygrade	Maximize

The APMS allows specification of 14 assignment policy parameters. A description of the policy parameters and the values chosen for this experiment are indicated in Table 2. Note that this test focuses on one Section only (PERS-404C, Aviation ratings/ communities AT, AE, AO, AF/AV/8300) and on the paygrades E-6 to E-9. Note also that the PRD Window is set to -3 to +4 months of the Sailors' PRD, and the Khaki Barrier[4] is not enforced. The impact on the MOEs of enforcing the Khaki Barrier is discussed later in this report.

Table 2
Assignment policy parameters and selected values

No.	Parameter	Description	Selected Value
1	Section	Desk code grouping	404C
2	Paygrade Range	An interval of paygrades considered	E-6-E-9
3	PRD Range	An interval of Sailors' PRDs considered	02/04 - 02/12
4	TUM Range	An interval of job TUMs considered	02/04 - 02/12
5	MCAs	Manning Control Authorities	LANT, PAC, BUPERS
6	Composites	General sea/shore composite (sea, shore)	Sea, Shore
7	Max Sea Gap	Maximum allowable gap for sea duty assignments	3 months
8	Max Shore Gap	Maximum allowable gap for shore duty assignments	3 months
9	Max PRD vs. Class Gap	Maximum allowable gap between Sailor's PRD and class convening date	4 months
10	Max Class vs. TUM Gap	Maximum allowable gap between class convening date and job TUM	2 months
11	PRD Window	A range of job TUMs, defined by months preceding and following a Sailor's PRD, for which he is considered assignable	-3 to +4
12	Paygrade vs. Billet	An eligibility tolerance (min to max) for Sailor-to-job paygrade match. A common example is the "one up, one down" rule practiced by some communities	0 to 1
13	Coast-to-Coast Allowed	Allow or disallow CONUS coast-to-coast PCS moves	Yes
14	Khaki Barrier Enforced	Allow or disallow E-6 to fill E-7 billets and vice-versa	No

Table 3 displays the size of each assignment problem solved and the breakdown of the number of runs. The break down of the 144 runs is as follows:

- Fifty-four 1-month problems; one for each month-MOE combination
- Forty-eight 2-month problems; one for each 2-month-MOE combination
- Forty-two 3-month problems; one for each 3-month-MOE combination.

The set of 144 problems was solved twice. Once with Khaki Barrier (KB) not enforced and another with KB enforced. A detailed description of the results with KB not enforced, along with a comparison when KB is enforced is reported later.

The last column of Table 3 indicates the maximum number of possible assignments in each problem, which is equal to the minimum of the number of Sailors and the number of jobs in the problem. This column provides a reference on the bounds set by problem size on the *Number of Assignments* MOE discussed next.

Table 3
Solved optimization problems

Exp No.	Cycle Length	Experiment Month(s)	No. of Sailors	No. of Jobs	No. of Optimizations	Maximum Possible Assignments
1		APR	20	138	6	20
2		MAY	52	48	6	48
3		JUN	34	28	6	28
4		JUL	88	40	6	40
5	1-Month	AUG	67	28	6	28
6		SEP	77	55	6	55
7		OCT	129	88	6	88
8		NOV	113	65	6	65
9		DEC	155	101	6	101
10		APR-MAY	78	186	6	78
11		MAY-JUN	101	76	6	76
12		JUN-JUL	142	68	6	68
13		JUL-AUG	168	69	6	69
14	2-Month	AUG-SEP	148	84	6	84
15		SEP-OCT	208	143	6	143
16		OCT-NOV	243	153	6	153
17		NOV-DEC	269	166	6	166
18		APR-MAY-JUN	138	214	6	138
19		MAY-JUN-JUL	216	116	6	116
20		JUN-JUL-AUG	229	97	6	97
21	3-Month	JUL-AUG-SEP	246	124	6	124
22		AUG-SEP-OCT	279	172	6	172
23		SEP-OCT-NOV	321	208	6	208
24		OCT-NOV-DEC	399	254	6	254
				Total	**144**	

Note that the test data set covers a wide range of problem sizes. In particular, the number of Sailors ranges from 20 to 399 and the number of jobs ranges from 28 to 254.

Simulation Results

Number of Assignments

The highest priority objective in APMS is to maximize the number of assignments. This MOE is hard coded to have higher priority than all other MOEs. Table 4 displays the results of optimizing this MOE in 24 problems: nine one-month problems, eight two-month problems and seven three-month problems.

Table 4
Number of assignments for 24 problems

Experiment Month(s)	No. of Assignments	Experiment Month(s)	No. of Assignments	Experiment Month(s)	No. of Assignments
APR	20	APR-MAY	73	APR-MAY-JUN	115
MAY	44	MAY-JUN	74	MAY-JUN-JUL	116
JUN	28	JUN-JUL	68	JUN-JUL-AUG	97
JUL	40	JUL-AUG	69	JUL-AUG-SEP	124
AUG	29	AUG-SEP	84	AUG-SEP-OCT	172
SEP	54	SEP-OCT	143	SEP-OCT-NOV	208
OCT	88	OCT-NOV	153	OCT-NOV-DEC	254
NOV	65	NOV-DEC	166		
DEC	101				

The results presented in Table 4 are all absolute numbers that are difficult to compare because of the overlapping months in the 2- and 3-month cycles. For example, in the 1-month case the June jobs appear in only one grouping (June). In the two-month case, however, June's jobs appear in two groupings (MAY-JUN and JUN-JUL) and in the 3-month case they appear in three groupings (APR-MAY-JUN and MAY-JUN-JUL and JUN-JUL-AUG). As such, one would always expect there to be more total assignments across the eight 2-month groupings than across the nine 1-month groupings. As such, comparing the total assignments across the 1-, 2-, and 3-month groupings is not meaningful. In the next two sections we aggregate to create identical groupings (in terms of the jobs and Sailors included) that permit comparison and analysis. From these matched comparisons, inferences can be more readily drawn.

Percentage Improvement across Each Two and Three-Month Grouping

Table 5 summarizes the results of Table 4 to compare the number of assignments achieved using a 1-month versus a 2-month job cycle. The comparison indicates an improvement of up to 14.06 percent due to increasing the job cycle from one month to two months.

Table 5
Number of assignments: 1- vs. 2-month cycle

Experiment Month(s)	1-Month Assignments	2-Month Assignments	% Improvement
APR-MAY	64	73	14.06%
MAY-JUN	72	74	2.78%
JUN-JUL	68	68	0.00%
JUL-AUG	69	69	0.00%
AUG-SEP	83	84	1.20%
SEP-OCT	142	143	0.70%
OCT-NOV	153	153	0.00%
NOV-DEC	166	166	0.00%

Note that there is significant variation and that several cases indicate no improvement at all. In these cases the one-month problems achieved the maximum possible number of assignments. Hence, there was no room for improvement for the two-month problems.

Table 6 summarizes the results of Table 4 to compare the number of assignments achieved using a 1-month versus a 3-month job cycle. The number indicated in the "1-Month Assignments" column is the sum of the assignments achieved in the experiment months listed. The comparison indicates an improvement of up to 25 percent due to increasing the job cycle from one month to three months. Again, there is significant variation over time.

Table 6
Number of assignments: 1- vs. 3-month cycle

Experiment Month(s)	1-Month Assignments	3-Month Assignments	% Improvement
APR-MAY-JUN	92	115	25.00%
MAY-JUN-JUL	112	116	3.57%
JUN-JUL-AUG	97	97	0.00%
JUL-AUG-SEP	123	124	0.81%
AUG-SEP-OCT	171	172	0.58%
SEP-OCT-NOV	207	208	0.48%
OCT-NOV-DEC	254	254	0.00%

Annual Percentage Improvement across 2 and 3-Month Groupings

The Table 5 and Table 6 comparisons are based on one problem at a time. Tables 7 and 8 summarize the results of Table 4 to compare the total number assigned. Problems are partitioned to safeguard against double counting. The results displayed in Table 7 indicate an increase of 10 assignments, which is equivalent to 2.7 percent improvement for extending the cycle to two months. The annual figure is abstracted from the intra-year variation in order to generate an annual expected percent increase due to increasing the cycle time from one to two months.

Table 7
Total number of assignments: 1- vs. 2 months

Experiment Month(s)	1-Month Assignments	Experiment Month(s)	2-Month Assignments
APR	20	APR-MAY	73
MAY	44		
JUN	28	JUN-JUL	68
JUL	40		
AUG	29	AUG-SEP	84
SEP	54		
OCT	88	OCT-NOV	153
NOV	65		
Total	**368**	**Total**	**378**

The results displayed in Table 8 indicate that extending the job cycle to three months adds 24 assignments, which is equivalent to a 5.1 percent improvement annually.

Table 8
Number of assignments: 1 vs. 3 months

Experiment Month	1-Month Assignments	Experiment Months	3-Month Assignments
APR	20		
MAY	44	APR-MAY-JUN	115
JUN	28		
JUL	40		
AUG	29	JUL-AUG-SEP	124
SEP	54		
OCT	88		
NOV	65	OCT-NOV-DEC	254
DEC	101		
Total	**469**	**Total**	**493**

NEC Reutilization

Table 9 displays the results of optimizing the NEC Reutilization MOE in 24 problems. The column entitled “Optimum (MAX)” presents the best case NEC reutilization percentage. The column entitled “Worst Case (MIN)” presents the lowest percentage of NEC reutilization associated with this data set. The results presented in the row entitled “Average” indicate that the NEC reutilization MOE improved steadily, as expected, with increasing job cycle lengths.

Table 9
NEC Reutilization for the 24 problems

Cycle Length	Experiment Month(s)	Worst Case (MIN)	Optimum (MAX)	No. of Assignments
1-Month	APR	15.00%	65.00%	20
	MAY	20.00%	36.00%	44
	JUN	11.00%	32.00%	28
	JUL	23.00%	63.00%	40
	AUG	45.00%	66.00%	29
	SEP	11.00%	46.00%	54
	OCT	23.00%	63.00%	88
	NOV	20.00%	77.00%	65
	DEC	11.00%	74.00%	101
	Average	**19.89%**	**58.00%**	
2-Month	APR-MAY	12.00%	56.00%	73
	MAY-JUN	18.00%	46.00%	74
	JUN-JUL	19.00%	65.00%	68
	JUL-AUG	30.00%	78.00%	69
	AUG-SEP	21.00%	62.00%	84
	SEP-OCT	18.00%	65.00%	143
	OCT-NOV	22.00%	76.00%	153
	NOV-DEC	13.00%	82.00%	166
	Average	**19.13%**	**66.25%**	
3-Month	APR-MAY-JUN	17.00%	64.00%	115
	MAY-JUN-JUL	17.00%	60.00%	116
	JUN-JUL-AUG	24.00%	72.00%	97
	JUL-AUG-SEP	26.00%	77.00%	124
	AUG-SEP-OCT	22.00%	67.00%	172
	SEP-OCT-NOV	19.00%	75.00%	208
	OCT-NOV-DEC	16.00%	82.00%	254
	Average	**20.14%**	**71.00%**	

Tables 10 and Table 11 provide another view of the NEC reutilization results. Here the percentage improvement is computed for each pair of equivalent problems. The comparisons of Table 10 reveal that the expected improvement ranges between 8.57 and 36.84 percent when we increase the cycle length to two months. The average improvement is 18.89 percent. Table 11 comparisons indicate that a 3-month cycle will provide better improvement ranging from 14.86 to 37.40 percent with an average of 28.39 percent.

Table 10
NEC reutilization: 1- vs. 2-month cycle

Experiment Month(s)	1-Month	2-Month	% Improvement
APR-MAY	50.50%	56.00%	10.89%
MAY-JUN	34.00%	46.00%	35.29%
JUN-JUL	47.50%	65.00%	36.84%
JUL-AUG	64.50%	78.00%	20.93%
AUG-SEP	56.00%	62.00%	10.71%
SEP-OCT	54.50%	65.00%	19.27%
OCT-NOV	70.00%	76.00%	8.57%
NOV-DEC	75.50%	82.00%	8.61%
Average	**56.56%**	**66.25%**	**18.89%**

Table 11
NEC reutilization: 1- vs. 3-month cycle

Experiment Month(s)	1-Month	3-Month	% Improvement
APR-MAY-JUN	44.33%	64.00%	44.36%
MAY-JUN-JUL	43.67%	60.00%	37.40%
JUN-JUL-AUG	53.67%	72.00%	34.16%
JUL-AUG-SEP	58.33%	77.00%	32.00%
AUG-SEP-OCT	58.33%	67.00%	14.86%
SEP-OCT-NOV	62.00%	75.00%	20.97%
OCT-NOV-DEC	71.33%	82.00%	14.95%
Average	**55.95%**	**71.00%**	**28.39%**

PCS Cost

Table 12 displays the results of optimizing the PCS Cost MOE in the 24 test problems. The column entitled "Optimum (MIN)" presents the minimum average PCS cost per assignment for the problem solved. The column entitled "Worst Case (MAX)" represents the maximum average PCS cost per assignment. Comparing MIN to MAX provides insight into the potential savings between the best and worst solutions.

Table 12
PCS costs for the 24 problems

Cycle Length	Experiment Month(s)	Optimum (MIN)	Worst Case (MAX)	No. of Assignments
1 Month	APR	$4,217	$15,155	20
	MAY	$4,372	$9,858	44
	JUN	$3,540	$8,488	28
	JUL	$2,434	$8,336	40
	AUG	$1,578	$8,658	29
	SEP	$3,040	$10,181	54
	OCT	$2,641	$9,899	88
	NOV	$1,703	$9,613	65
	DEC	$1,721	$10,129	101
2 Months	APR-MAY	$2,424	$12,562	73
	MAY-JUN	$3,078	$9,828	74
	JUN-JUL	$2,010	$8,674	68
	JUL-AUG	$1,276	$8,657	69
	AUG-SEP	$1,626	$9,921	84
	SEP-OCT	$2,079	$10,281	143
	OCT-NOV	$1,514	$9,939	153
	NOV-DEC	$1,205	$10,853	166
3 Months	APR-MAY-JUN	$1,725	$11,242	115
	MAY-JUN-JUL	$2,147	$9,759	116
	JUN-JUL-AUG	$1,136	$8,936	97
	JUL-AUG-SEP	$1,199	$10,003	124
	AUG-SEP-OCT	$1,469	$10,154	172
	SEP-OCT-NOV	$1,487	$10,302	208
	OCT-NOV-DEC	$1,019	$10,590	254

Per Move Comparison

Table 13 provides a comparison of average PCS cost when solving a 1-month cycle vs. a 2-month cycle problem. The "PCS Cost one Month" column is the weighted average of two 1-month problems. For example, the first entry in this column is computed from Table 12 data as follows:

PCS Cost -one Month (APR-MAY) = (20 $*$ $4,217 + 44 $*$ $4,372) / (20 + 44)

The PCS Cost 2-Month is the PCS cost per assignment for the 2-month problem. The "% Savings" column represents the improvement of a 2-month cycle over a 1-month cycle. The same logic applies to Table 14.

The results reveal the significant savings that can be realized by having a longer job cycle. In the 2-month case the improvement ranges between 23.973 and 43.94 percent with an average of 32.53 percent. In the 3-month case the savings improves significantly to an average value of 47.84 percent while making at least as many assignments. In most cases though, the number of assignments also increases.

Table 13
PCS cost: 1- vs. 2-month cycle

Experiment Month(s)	No. of Assignments 1-Month	No. of Assignments 2-Month	PCS Cost 1-Month	PCS Cost 2-Month	% Savings
APR-MAY	64	73	$4,324	$2,424	43.94%
MAY-JUN	72	74	$4,048	$3,078	23.97%
JUN-JUL	68	68	$2,889	$2,010	30.44%
JUL-AUG	69	69	$2,074	$1,276	38.48%
AUG-SEP	83	84	$2,529	$1,626	35.71%
SEP-OCT	142	143	$2,793	$2,079	25.56%
OCT-NOV	153	153	$2,243	$1,514	32.49%
NOV-DEC	166	166	$1,714	$1,205	29.69%
Average			**$2,827**	**$1,902**	**32.53%**

Table 14
PCS Cost: 1- vs. 3-months cycle

Experiment Month(s)	No. of Assignments 1-Month	No. of Assignments 3-Month	PCS Cost 1-Month	PCS Cost 3-Month	% Savings
APR-MAY-JUN	92	115	$4,085	$1,725	57.77%
MAY-JUN-JUL	112	116	$3,472	$2,147	38.16%
JUN-JUL-AUG	97	97	$2,497	$1,136	54.51%
JUL-AUG-SEP	123	124	$2,498	$1,199	52.01%
AUG-SEP-OCT	171	172	$2,587	$1,469	43.21%
SEP-OCT-NOV	207	208	$2,451	$1,487	39.32%
OCT-NOV-DEC	254	254	$2,035	$1,019	49.93%
Average			**$2,804**	**$1,455**	**47.84%**

Total Cost Comparison

Tables 15 and 16 provide insight into the savings in total PCS costs. The column "EM" indicates the experiment month(s). The column "Optimum (MIN)" indicates the optimum, or minimum PCS cost per assignment. The column "NOA" indicates the number of assignments. The "Total PCS Cost" is computed simply by multiplying MIN by NOA.

Table 15 provides a comparison of the total PCS Cost between 1- and 2- month cycles over a period of eight months from APR to NOV. The results indicate a savings of $344,355 or 33.55 percent while filling 10 more billets.

Table 15
Total PCS Cost: 1- vs. 2-month cycle

EM	Optimum (MIN)	NOA	Total PCS Cost	EM	Optimum (MIN)	NOA	Total PCS Cost	% Savings
APR	$4,217	20	$84,340					
MAY	$4,372	44	$192,368	APR-MAY	$2,424	73	$176,952	
JUN	$3,540	28	$99,120					
JUL	$2,434	40	$97,360	JUN-JUL	$2,010	68	$136,680	
AUG	$1,578	29	$45,762					
SEP	$3,040	54	$164,160	AUG-SEP	$1,626	84	$136,584	
OCT	$2,641	88	$232,408					
NOV	$1,703	65	$110,695	OCT-NOV	$1,514	153	$231,642	
Average	**$2,941**	**368**	**$1,026,213**	**Average**	**$1,894**	**378**	**$681,858**	**33.55%**

Table 16 provides a comparison of the total PCS Cost between 1- and 3-month cycles over a period of nine months from APR to DEC. The results indicate a savings of $594,157 or 49.5 percent while filling 24 more billets.

Table 16
Total PCS Cost: 1- vs. 3-month cycle

EM	Optimum MIN	NOA	Total PCS Cost	EM	Optimum MIN	NOA	Total PCS Cost	% Savings
APR	$4,217	20	$84,340	APR-MAY-JUN	$1,725	115	$198,375	
MAY	$4,372	44	$192,368					
JUN	$3,540	28	$99,120					
JUL	$2,434	40	$97,360	JUL-AUG-SEP	$1,199	124	$148,676	
AUG	$1,578	29	$45,762					
SEP	$3,040	54	$164,160					
OCT	$2,641	88	$232,408	OCT-NOV-DEC	$1,019	254	$258,826	
NOV	$1,703	65	$110,695					
DEC	$1,721	101	$173,821					
Average	**$2,805**	**469**	**$1,200,034**	**Average**	**$1,315**	**493**	**$605,877**	**49.50%**

Gap/Overlap

Table 17 displays the results of optimizing the Gap/Overlap MOE for the 24 test problems. This MOE is computed by the following formulas:

$$Gap/Overlap = |EDA - TUM| \ for \ a \ particular \ Sailor \rightarrow job \ match$$

$$Gap/Overlap \ MOE = \frac{Sum \ (Gaps/Overlaps)}{Number \ of \ Assignments}$$

An assignment is assumed to have zero Gap/Overlap if the Sailor's EDA is equal to the job TUM. The absolute value of the number of months, late or early, is used to prevent gaps and overlaps from canceling each other out.

The results of this experiment, as displayed in Table 17, show a constant Gap/Overlap of 0 months. That is, given this particular data set, APMS was able to send everybody on the right month in the 1-month cycle problems. Obviously, this does not leave any room for Gap/Overlap improvement by increasing the job cycle to two months or three months. However, increasing the job cycle length does result in an increase in job assignments without degradation of the Gap/Overlap results.

Table 17
Gap/Overlap for the 24 problems

Cycle Length	Experiment Month(s)	Optimum (MIN)	(MAX)	No. of Assignments
1 Month	APR	0.00	1.00	20
	MAY	0.00	0.00	20
	JUN	0.00	1.00	20
	JUL	0.00	0.00	44
	AUG	0.00	0.00	44
	SEP	0.00	0.00	44
	OCT	0.00	0.00	44
	NOV	0.00	0.00	44
	DEC	0.00	0.00	44
	AVG	**0.00**	**0.22**	
2 Months	APR-MAY	0.00	2.00	73
	MAY-JUN	0.00	1.00	74
	JUN-JUL	0.00	1.00	68
	JUL-AUG	0.00	1.00	69
	AUG-SEP	0.00	1.00	84
	SEP-OCT	0.00	1.00	143
	OCT-NOV	0.00	1.00	153
	NOV-DEC	0.00	1.00	166
	AVG	**0.00**	**1.13**	
3 Months	APR-MAY-JUN	0.00	2.00	115
	MAY-JUN-JUL	0.00	2.00	116
	JUN-JUL-AUG	0.00	1.00	97
	JUL-AUG-SEP	0.00	2.00	124
	AUG-SEP-OCT	0.00	1.00	172
	SEP-OCT-NOV	0.00	1.00	208
	OCT-NOV-DEC	0.00	0.00	254
	AVG	**0.00**	**1.29**	

On-Time Arrival

Table 18 displays the results of optimizing the On-Time Arrival MOE for the 24 test problems. An assignment is assumed to be on time if the Sailor's Estimated Date of Arrival (EDA) is equal to the job TUM. This MOE is related to the Gap/Overlap MOE. However, it is computed differently and optimizes over number of on-time assignments instead of the size of the gap/overlap. As shown below, the On-Time Arrival MOE is computed as the percentage of assignments that are on time.

$$On\text{-}Time\ Arrival\ MOE = \frac{Number\ of\ Sailors\ with\ On\text{-}time\ Arrival}{Number\ of\ Assignments}$$

Table 18
On-time arrival for the 24 problems

Cycle Length	Experiment Month(s)	Worst Case (MIN)	Optimum (MAX)	No. of Assignments
1 Month	APR	65.00%	100.00%	20
	MAY	93.00%	93.00%	44
	JUN	89.00%	93.00%	28
	JUL	93.00%	100.00%	40
	AUG	93.00%	93.00%	29
	SEP	96.00%	100.00%	54
	OCT	93.00%	99.00%	88
	NOV	91.00%	100.00%	65
	DEC	90.00%	100.00%	101
2 Months	APR-MAY	4.00%	90.00%	73
	MAY-JUN	15.00%	92.00%	74
	JUN-JUL	29.00%	97.00%	68
	JUL-AUG	25.00%	97.00%	69
	AUG-SEP	27.00%	96.00%	84
	SEP-OCT	23.00%	99.00%	143
	OCT-NOV	20.00%	99.00%	153
	NOV-DEC	17.00%	100.00%	166
3 Months	APR-MAY-JUN	2.00%	81.00%	115
	MAY-JUN-JUL	15.00%	93.00%	116
	JUN-JUL-AUG	14.00%	96.00%	97
	JUL-AUG-SEP	3.00%	98.00%	124
	AUG-SEP-OCT	6.00%	98.00%	172
	SEP-OCT-NOV	1.00%	100.00%	208
	OCT-NOV-DEC	2.00%	100.00%	254

Tables 19 and 20 compare this MOE for the 2- and 3-month cycles. The comparison indicates that the On-Time Arrival MOE deteriorates as we increase cycle length. This can be explained by considering that for a given time period, more assignments were made in longer cycle problems as indicated in the last column of Table 18. For example, consider the two 1-month problems APR and MAY as compared to the 2-month problem APR-MAY. The weighted average of the two 1-month problems, as shown in Table 19, is 95.19 percent. Thus, in the 1-month cycle case, (0.9519 * 64 =) 61 on-time assignments were made. On the other hand, (0.90 * 73=) 66 on-time assignments were made solving the 2-month problem, 5 more than the 1-month problem. When the cycle length was increased from one to two months, nine more total assignments were added, but only five more on-time assignments were added, making the on-time arrival rate for the additional jobs only 63.3 percent. This low additional percentage reduced the total percent on time from 95.19 percent in the 1-month case to only 90 percent in the 2-month case. Thus, it seems that the deterioration in the percentage of on-time arrivals is the price paid for maximizing the number of assignments. However, more experiments involving other sample populations may provide better insight.

Table 19
On-time arrival: 1- vs. 2-months cycle

Experiment Month(s)	1-Month	2-Month	% Improvement
APR-MAY	95.19%	90.00%	-5.45%
MAY-JUN	93.00%	92.00%	-1.08%
JUN-JUL	97.12%	97.00%	-0.12%
JUL-AUG	97.06%	97.00%	-0.06%
AUG-SEP	97.55%	96.00%	-1.59%
SEP-OCT	99.38%	99.00%	-0.38%
OCT-NOV	99.42%	99.00%	-0.42%
NOV-DEC	100.00%	100.00%	0.00%
AVG	**97.34%**	**96.25%**	**-1.14%**
Total Assigned (Non-overlapping problems) Table 7	**368**	**378**	**2.7%**

Table 20
On-time arrival: 1- vs. 3-month cycle

Experiment Month(s)	1-Month	3-Month	% Improvement
APR-MAY-JUN	94.52%	81.00%	-14.30%
MAY-JUN-JUL	95.50%	93.00%	-2.62%
JUN-JUL-AUG	95.89%	96.00%	0.11%
JUL-AUG-SEP	98.35%	98.00%	-0.36%
AUG-SEP-OCT	98.30%	98.00%	-0.31%
SEP-OCT-NOV	99.57%	100.00%	0.43%
OCT-NOV-DEC	99.65%	100.00%	0.35%
AVG	**97.40%**	**95.14%**	**-2.38%**
Total Assigned (Non-overlapping problems) Table 8	**469**	**493**	**5.1%**

Paygrade Match

Table 24 displays the results of optimizing the Paygrade Match MOE for the 24 test problems. The MOE values for 1-, 2-, and 3-month cycles are compared in Tables 25 and 26. The results indicate slight improvements due to an increased job cycle.

Table 24
Paygrade match results for the 24 problems

Cycle Length	Experiment Month(s)	Worst Case (MIN)	Optimum (MAX)	No. of Assignments
1-Month	APR	20.00%	90.00%	20
	MAY	86.00%	95.00%	44
	JUN	68.00%	68.00%	28
	JUL	100.00%	100.00%	40
	AUG	97.00%	97.00%	29
	SEP	85.00%	85.00%	54
	OCT	88.00%	88.00%	88
	NOV	97.00%	97.00%	65
	DEC	96.00%	96.00%	101
	AVG	**81.89%**	**90.67%**	

Table 24
Paygrade match results for the 24 problems

2-Month	APR-MAY	29.00%	92.00%	73
	MAY-JUN	80.00%	85.00%	74
	JUN-JUL	100.00%	100.00%	68
	JUL-AUG	100.00%	100.00%	69
	AUG-SEP	94.00%	94.00%	84
	SEP-OCT	94.00%	94.00%	143
	OCT-NOV	94.00%	94.00%	153
	NOV-DEC	98.00%	98.00%	166
	AVG	**86.13%**	**94.63%**	
3-Month	APR-MAY-JUN	32.00%	98.00%	115
	MAY-JUN-JUL	97.00%	97.00%	116
	JUN-JUL-AUG	100.00%	100.00%	97
	JUL-AUG-SEP	100.00%	100.00%	124
	AUG-SEP-OCT	98.00%	98.00%	172
	SEP-OCT-NOV	96.00%	96.00%	208
	OCT-NOV-DEC	97.00%	97.00%	254
	AVG	**88.57%**	**98.00%**	

Table 25
Paygrade match: 1- vs. 2-month cycle

Experiment Month(s)	1-Month	2-Month	% Improvement
APR-MAY	93.44%	92.00%	-1.54%
MAY-JUN	84.50%	85.00%	0.59%
JUN-JUL	86.82%	100.00%	15.18%
JUL-AUG	98.74%	100.00%	1.28%
AUG-SEP	89.19%	94.00%	5.39%
SEP-OCT	86.86%	94.00%	8.22%
OCT-NOV	91.82%	94.00%	2.37%
NOV-DEC	96.39%	98.00%	1.67%
Average	**90.97%**	**94.63%**	**4.14%**

Table 26
Paygrade match: 1- vs. 3-month cycle

Experiment Month(s)	1-Month	3-Month	% Improvement
APR-MAY-JUN	85.70%	98.00%	14.36%
MAY-JUN-JUL	90.04%	97.00%	7.74%
JUN-JUL-AUG	89.87%	100.00%	14.36%
JUL-AUG-SEP	92.71%	100.00%	7.74%
AUG-SEP-OCT	88.58%	98.00%	11.28%
SEP-OCT-NOV	90.04%	96.00%	7.87%
OCT-NOV-DEC	93.48%	97.00%	3.76%
Average	**90.09%**	**98.00%**	**9.58%**

Enforcing the Khaki Barrier

To investigate the impact on the Navy MOEs due to enforcing the Khaki barrier (KB), we solved the same 144 assignment problems described in Table 3 using the parameters specified in Table 2 with the additional constraint of the Khaki Barrier.

Table 27 provides a comparative display of a sample of the results for the seven MOEs. Analyzing Table 27 data we may conclude the following:

1. In general, enforcing the Khaki Barrier slightly deteriorates the Navy MOEs. This deterioration is expected since enforcing the barrier essentially adds a constraint to an optimization problem.
2. When KB is enforced, Paygrade Match does not improve significantly by increasing the cycle length. This decrease in improvement occurs because the one-month match is already very good for this data set, leaving little room for improvement. Although Paygrade Match does not improve significantly, more assignments are made with an increased cycle length.
3. When there is sufficient room for improvement, MOEs always improve by increasing the cycle from one to three months whether the KB is enforced or not.

Table 27
Enforcing the Khaki Barrier: 1- vs. 3-month cycle

MOE No.	MOE	1-Month Cycle: Khaki Barrier Enforced	1-Month Cycle: Khaki Barrier Not Enforced	3-Month Cycle: Khaki Barrier Enforced	3-Month Cycle: Khaki Barrier Not Enforced
1.	Total assigned	447	469	489	493
2.	Average NEC Reutilization	57.67%	58%	68.71%	71%
3.	Total PCS Cost	$1,266,538	$1,200,034	$852,480	$605,877
4.	Gap / Overlap	0%	0%	0%	0%
5.	On Time Arrival	97.32%	97.40%	91.43%	95.14%
6.	Paygrade Match	98.65%	90.67%	98.46%	98%

Conclusions and Recommendations

Conclusions

The results presented in this document suggest potentially significant gains in several Navy MOEs by increasing the job cycle length to two or three months. In particular, the number of assignments, PCS costs, and NEC reutilization improved remarkably with increasing the cycle length.

Other MOEs showed little or no change when cycle length is increased. This lack of results may be a function of the data used. This experiment involved solving 288 optimum assignment problems for only one section (404C) and for only the E-6 to E-9 paygrades. Further tests with other branches, ratings, or communities may help better identify the advantages and the disadvantages of moving to a wider job cycle.

This experiment also reveals the richness of the information that an optimization algorithm could provide personnel managers and policy makers in analyzing different assignment policy scenarios.

Recommendations

An increased job cycle length could greatly benefit both Enlisted Sailors and the Navy. The Navy should consider extending the job cycle. However, before institutionalizing a specific change, the Navy should investigate the best implementation policy and associated business rules by conducting wider experimentation. Listed below are two business process recommendations that, if implemented, would facilitate job cycle extension. Supporting business rule changes are also listed.

Recommendation 1: Extend the Roller/Job Projection to 11 Months

In order to extend the job cycle up to three months and still maintain the ability to advertise jobs, move, and train Sailors, the roller/job projection must be extended to 11 months. This means that instead of projecting vacancies 9 months into the future, the Navy must be able to accurately project vacancies 11 months into the future. Under current business practices, it is not possible to make such predictions accurately, mainly because of existing policies governing the Enlisted distribution system's demand signal.

Recommendation 1a: Align PRD and EAOS for all Sailors. Currently, when a Sailor has a PRD that is not aligned with his EAOS, he can often renegotiate orders before reaching his PRD by reenlisting or threatening to leave the service. Besides altering tour lengths and incurring additional PCS costs, this PRD flexibility tends to create problems for a distribution system that makes its projections based solely on Sailors' PRDs. By setting (or making assignments such that) Sailors' PRD = EAOS one element of uncertainty could be removed from the system.

Though simple in concept, this recommendation should be pursued very carefully as there are many cultural issues involved in the definition of enlistment terms. One option for implementation may be to extend contract lengths to match job assignments, similar to Officer assignment.

Recommendation 1b: Gather Sailors' Career Intentions 12 Months in Advance. If the alignment of PRD and EAOS can be accomplished, then career intentions become less of a factor in making accurate projections. However, without PRD and EAOS alignment, career intentions provide a strong predictor of future Sailor separation and retention.

Recommendation 1c: Assign Sailors and Jobs to Billet Identification Numbers (BINs). In the current Enlisted distribution system, Sailors are assigned to jobs that have been identified by an algorithm using projected vacancies, not by actual predicted billet vacancies. These projections are largely dependent upon inventory versus BA gaps by paygrade and, to a lesser degree, actual manpower vacancies. Unfortunately, there is no link between a Sailor and a specific job (once assigned). The command simply has a certain number of Sailors at each paygrade and rating that the Commanding Officer may assign to any billet. This lack of billet/Sailor association affects vacancy projection and many other areas of distribution.

There are two primary ways that associating jobs, and thus Sailors, to billet identification numbers (BINs) could improve the Navy's ability to confidently project vacancies 11 months in the future. First, BIN association would help mitigate some of the problems associated with rank advancements. Currently, paygrade is a main driver in the distribution system. Because there is no link between a Sailor and the job he fills, when a Sailor advances to the next paygrade, a vacancy may be projected for his former paygrade even though he continues to fill the same manpower "position." Hence, projections are often skewed by advancements.

Second, BIN association would simplify the problems caused by BA changes. As billets are funded or unfunded, BA changes accordingly. Identifying those billets and the Sailors filling them by BIN would give a manpower/personnel manager clear indication of whether or not a projected vacancy will be funded for a replacement. The changes in BA will always hinder the ability to project accurately, but tying the jobs directly to a funding status should help the distribution system project more accurately.

Recommendation 2: Change From Sequential to Batch Assignments. All the improvements noted in this paper result from an increased number of Sailors and jobs in the assignment pool and from simultaneous assignment instead of sequential assignment. Assignments are optimized according to various user-defined metrics. As the number of Sailors and jobs in a given cycle increases, the opportunity to find matches generating better outcomes for both Sailors and the Navy also increases. Unfortunately, it also becomes much more difficult for a human to identify that set of optimal assignments. Hence, a computational optimization algorithm is needed to recommend optimal assignments to achieve the full potential of increased job cycle lengths.

Recommendation 2a: Implement Optimization Technology into the Assignment Process. While the Navy stands to gain much from extending the job cycle, it also risks losing much if the technology to support the extension is not developed and implemented. By extending the job cycle, as proposed in this analysis, the pool of Sailors and jobs increases, giving more possibilities for assignment and thus more opportunity for optimum solutions. That increased opportunity, however, is only one end of the spectrum. The same mathematical concept that makes it possible to gain makes it possible to lose. By widening the size of the problem, the "boundaries" (best possible and worst possible values) of the solution become more distant, meaning that the worst-case solution obtained through optimization could be less desirable than the worst-case solution obtained through a sequential, one-month approach. To prevent selection of such a solution, optimization technology should be used.

Recommendation 2b: Design Enlisted Assignment Business Process Infrastructure to Utilize Extended Projections and Optimization Technology. There are many business rules in effect today in the Enlisted assignment process that could hinder the ability to move to a batch process for assignment making. These rules exist to provide flexibility for the distribution system, allowing it to meet fleet requirements while being fair to Sailors. In order to move to a batch process for assignments, PERS-4 must review current business rules, identify any hindrances, and establish new business rules to support the batch process. The ideal new business process would retain flexibility for the Enlisted distribution system, be fair and equitable to Sailors, and allow optimized batch processing of large numbers of Sailors and jobs. A notional process, approved by PERS-40 and the MCAs in August 2003, is located in the Appendix.

Glossary

APMS	Assignment Policy Management System, a prototype Enlisted slating tool
BA	Billets Authorized (funded and determined needed by Navy)
Desk Code	A code corresponding to a particular detailer and his constituents, partitioning Sailors by EMC and paygrade
EAOS	End of Active Obligated Service
EDA	Estimated Date of Arrival
EMC	Enlisted Management Community
FRP	Fleet Response Plan
Khaki Barrier	An institutional rule that, in general, prohibits paygrades below E-7 being detailed to E-7 and above jobs, and vice-versa from above to below.
MCA	Manning Control Authority: MCAB (BUPERS), MCAL (Atlantic), MCAP (Pacific), MCAR (Reserves)
MOE	Measure of Effectiveness
NEC	Navy Enlisted Classification
PCS	Permanent Change of Station
PERS-4	Head of Navy Distribution
PERS-40	Head of Enlisted Assignments
PRD	Projected Rotation Date, the date at which Sailors are planned to move to their next assignment
Job Cycle	A length of time in which jobs are produced, currently one month.
Sensitivity Analysis	An analysis used to determine the magnitude of aggregate consequences incurred from alternative decisions
Slate	A one-to-one matching of Sailors to jobs
TUM	Take Up Month

Appendix

MEMORANDUM

TO: Requisition Requirements Working Group

FROM: Tony Cunningham
Principal Investigator, Rotation Window/Optimized Slating Pilot

DATE: September 26, 2003

SUBJECT: Requisition Requirements from the Rotation Window Concept

This memorandum states the position of the Rotation Window working group concerning the effort to define the requirements for the requisition. Listed below are the six sections of this memorandum.

1 Rotation Window Business Rules, Version 7
2 Detailed Discussion of Timing and Requisition Projection
3 Detailed Discussion of Slating Requirements
4 MCA Eligibility/Screening Criteria Concerns
5 Data Elements Required for the ROTWIN
6 Functional Area Code (FAC) Definition, Description, and Applicability

It should be noted that, as they pertain to the ROTWIN concept, these requirements are <u>specifically related to generating the requisition</u>, which is a list of jobs to be filled at some designated time, prioritized by the <u>MCA</u>s. The requirements expressed in this document <u>do not pertain to the development of a tool to assist in the assignment</u> of Sailors to the jobs on the requisition. The MCAs, being the owner of the prioritization algorithms, must give concurrence to the new requisition system/process as it is being developed.

TC/rh

SECTION 1

25 September 2003

Rotation Window Business Rules
Version 7

Background:

The CNO has approved CFFC's Fleet Response Plan (FRP). Navy Personnel Command (PERS 4) is ready to *"create a culture of readiness"* while *"shaping the workforce of the 21st century"* through evolving and innovative assignment and distribution practices. A responsive Navy with a commitment to a *"culture of readiness"* requires a responsive personnel system capable of proactive functions vice consistently reactive functions. Minimization of personnel gaps are essential to the higher level of readiness required to sustain a substantial surge force and integral to training and maintenance processes. Modifying *"the cyclical manning processes of the past"* is key to maintaining our naval force at a higher level of readiness for extended periods.

Traditionally, our ships have relied on large crews to accomplish their missions. Today, our all-volunteer service is developing new combat capabilities and platforms that feature dramatic advancements in technology and reductions in crew size. The crews of modern warships are streamlined teams of operational, engineering, and information technology experts who collectively operate some of the most complex systems in the world. As optimal manning policies and new platforms reduce crew size further, we will increasingly need Sailors who are highly educated and expertly trained—AND—we will need those Sailors in numbers that are consistent across the *"emergency surge," "surge ready,"* and *"routine deployable"* stages of a ship's operational cycle.

The Rotation Window concept is one proactive function for better managing personnel rotation by establishing continuity of shipboard skills while minimizing gaps in critical assignments. It also provides added benefits to our Sailors over the existing distribution system through an increase in choice from an array of job vacancies available to an individual Sailor, and a better opportunity to ensure optimal matches between Sailors and jobs.

Today, a Sailor's rotation schedule is based upon a fairly static month for the Planned Rotation Date (PRD), with a window of time (-3/+4 months) around the PRD in which the Sailor can be moved. However, it is rarely used to the advantage of our Sailors or our Navy. When the PRD window is used, the Sailor is most typically moved early from his shore tour to meet an at-sea requirement, or late from his sea tour to a shore tour (usually to minimize a gap at sea). Both are acceptable within the PRD window, but less desirable from the Sailor's perspective, because he might not derive the benefit of the timing in his next job selection.

Rotation Window will allow the Navy to better assign Sailors in concert with their preferences, skills, and Navy readiness requirements. In Rotation Window, Sailors due for rotation in a specific calendar quarter will be allowed to place their applications (or bids) for available billets from one of three quarters – the quarter their rotation falls in, the preceding quarter, and following quarter. This equates to better job choice for the Sailor, and greater flexibility for the Navy in assigning personnel. Rotation Window will allow a Sailor to take a job that interests them sooner or later in their PRD cycle than the one month window that currently limits many assignment options, thus increasing opportunity in meeting preferences, By conducting billet selection and assignment on a quarterly basis, the Navy is allowed the benefit of increased numbers of Sailors in a given cycle to ensure level personnel loading.

This concept does not create additional personnel inventory; it presents a plan to better manage gaps associated with planned rotation. Rotation Window responds to Navy manning challenges by 1) offering better job selection to Sailors, 2) increasing timing flexibility in a Sailor's order negotiation process, 3) increasing flexibility within the distribution system to support the Fleet Response Program, 4) creating opportunity to reduce PCS expenditures, 5) creating opportunity to reutilize individuals' skills and training, and 6) mitigating impact of changes in manning by accession or reduction impacts from year to year.

Below is a list of business rules to support the Rotation Window concept. They assume a –3/+3 month early/late assignment window for Enlisted personnel. These business rules are somewhat notional, since actual implementation often reveals unrecognized or assumed business rules that are not captured and/or identified in the requirements process. However, these business rules are representative of the process requirements necessary to the success of the proposed ROTWIN.

Rotation Window Business Rules (-3/+3 month window):

1. The primary focus will be on the operational forces (Types 2 and 4 duty) and in support of the Fleet Response Program (FRP).
2. Replacements for sea duty rollers will be the first step in the process.
3. A –3/+3 month early/late assignment window will not be exceeded without approval. The amount of time spent in the composite as documented by Sea Duty or Shore Duty Commencement Dates, Navy needs, Sailor preferences, command input, etc., will be utilized to determine changes to window assignment.
4. Team detailing portal will be used to solicit personal input from Sailors.
    a. Strategic Communications team in conjunction with the working group will develop a PR plan to ensure Sailors are aware of the role Team Detailing input will play in this process and their next assignment.
5. Team detailing will be required of all career Sailors during the Rotation window process.
6. There will be a planning phase focused on the set of required billets (Take-up Months) 9 – 12 months in the future. During this phase the number of projected vacancies as opposed to projected fills will be evaluated. It will be necessary to determine the true number of personnel rolling from shore to sea as the first step. If the number of fills is less than the number of projected vacancies, the number of extensions and early departures will be determined. The total number of requisitions displayed will not exceed 95% of the available rollers.
    a. Available rollers from other windows must be strictly controlled. No more than 5% of rollers per quarter (no more than 2% per month) in quarter minus one ($\boldsymbol{Q_{-1}}$) through quarter plus one ($\boldsymbol{Q_{+1}}$) will be utilized. For example, if the actual window is April – June, then January – March is ($\boldsymbol{Q_{+1}}$) and July – September is ($\boldsymbol{Q_{-1}}$) (see **Section 2**).
    b. The central issue is to ensure that, as Sailors are being moved from one assignment quarter to another, the Navy does not encounter the situation of having inadequate personnel to meet its requirements in the target quarter.

7. Personnel will not be moved to the right at plus one month through plus three months unless there is no relief. Members will not be held beyond plus three months. OPHOLD/LEADERSHIP FLAGS will be an exception to this rule, but the 60-month Maximum Sea Tour (MST) still applies.
8. MCA Priority factors will be used to determine the jobs that are to be filled during the target window.
9. The results of the planning process at the twelve-month point will be expressed as a draft roller list and a draft projected billet fill list.
10. Roller count will be determined by BUPERS and disseminated to EPMAC and the MCA's (pending the automation of the requisition loading process).
11. Requisitions will be determined by EPMAC and the MCAs.
12. Sailors will be provided no less than 9 months notice of actual quarter for slate consideration in order to ensure their timely participation in the detailing process.
13. Orders will be issued for Sailors no less than 5 months prior to transfer.
14. Once assigned to a given window, the Sailor's orders will be issued to comply with required TUM without regard to original PRD.
15. Sailors will apply for jobs in JASS as is done today**.-TENTATIVE-**
16. Sailors can submit up to 5 applications in JASS for assignment.
17. Job applications and requisitions will be processed to develop initial optimal assignment slates for each detailer**. The priority of the slating objectives will be determined via collaboration between the MCAs and PERS-40 (preference, NEC reutilization, PCS costs, etc.).**
18. Assignment slates will be made available for concurrence by EPMAC and the MCAs prior to release.
19. Sailors that are not detailed to a billet on the slate will be detailed on the following slate.
20. Sailors on sea duty who opt in to the sea slate will be assigned for a full prescribed sea tour.
21. Sailors will be notified individually if they are moving at other than their specified PRD window. **(Action: PERS 45 will develop a notification methodology similar to the 13 month Team detailing spreadsheet.)**
22. The following criteria will be used to screen and select personnel to move early from shore duty when required:
    a. Volunteers
    b. Sailor who has been ashore the longest
    c. Sailor with the shortest previous sea tour
    d. Sailor with the most critical skills needed
    e. The best qualified Sailor
    f. Sailors from CNO Priority 1 and 2 or MCA Priority 3 activities will be considered last.
23. The following criteria will be used to screen and select personnel to remain at sea when required (in no particular order):
    a. Volunteers
    b. Least cumulative sea time
    c. Critical skill

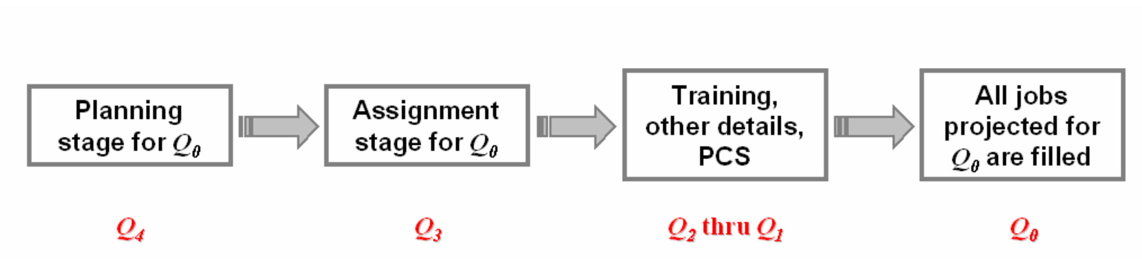
24. With the exception of initial accessions, spouse collocations, and EFM assignments, all Sailors will be assigned using the ROTWIN business process. Collocation “sea-side” assignment will be in slating process, but following spouse will not.
25. A gap will be defined as inventory short of Billets Authorized (Inv vs. BA) by some fidelity (e.g. paygrade).
26. BA and NMP changes will be applied during a slating cycle only as emergent requirements deem necessary.
27. When ADREQS are required, EPMAC is authorized to apply E4 and below. All E5 and above must be approved by the respective MCA.

SECTION 2

Detailed Discussion of Timing and Requisition Projection

The timing of the ROTWIN is crucial to the requisition projection and to performing optimized slating. The concept of optimized slating depends upon having a group of Sailors who, with a fair amount of certainty, will be assigned to a particular group of jobs. The size of these groups is based upon a "quarter's worth" of Sailors and jobs. This entails a planning process to determine the available rollers, and a 12-month projection to generate the sufficient number of requisitions and utilize the –3/+3 window.

It makes sense in this context to refer to the process flow in terms of quarters, denoted henceforth as $\boldsymbol{Q_i}$, with $\boldsymbol{i}$ being the index of the quarter being referenced. Here is a chronological representation of the quarters in the ROTWIN, with a description of the quarters following.



$\boldsymbol{Q_4}$ *Planning Phase*

- Gather preferences via team detailing and detailer contact from Sailors with PRDs in $\boldsymbol{Q_0}$ and any others in $\boldsymbol{Q_1}$ and $\boldsymbol{Q_{-1}}$ (the quarter immediately after $\boldsymbol{Q_0}$) who may wish to extend or transfer early.
- Once preferences have been gathered, the MCAs provide input, and the jobs and Sailors that will be in the window are determined.
- From this, a rough draft of the requisition projection for $\boldsymbol{Q_0}$ is determined.

$\boldsymbol{Q_3}$ *Detailing Phase*

- MCAs submit prioritized requisition lists to EPMAC
- Placement function
- Detailer scrub
- Jobs posted on JASS. Sailors have four weeks to make applications. **By this time, the jobs and people being considered are, except by extenuating circumstances, "fixed"** (see ROTWIN Business Rule #26).
- Optimized slates are generated, negotiations are made, and Sailors receive orders.

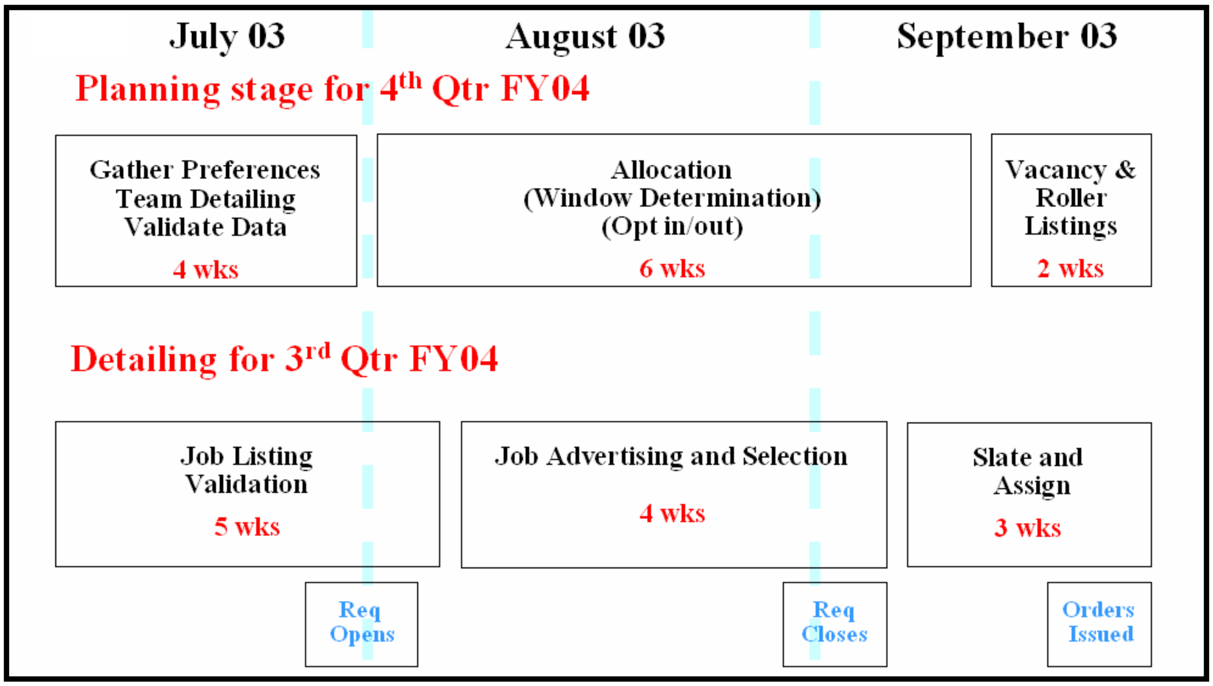
$\boldsymbol{Q_2}$ *thru* $\boldsymbol{Q_1}$ *Sailor Assignment Preparation Phase*

- Sailors may receive training, if available
- Depending on TUM of the job, Sailors may PCS in this phase

Q_0 ***Primary PCS Phase***

- All jobs projected to be filled in Q_0 are filled in this phase.

Keep in mind that this process carries from quarter to quarter. That is, once this process is in place, in any given quarter the detailers, placement folks, MCAs, and others involved will be planning, projecting, and assigning. The picture below shows the nature of this cascading type process.



In short, the ***basic*** requirements for the requisition, as related to the timing of the ROTWIN, are as follows:

- Need a projection of jobs in Q_3 for Q_0, as described above (12-month req)

- The pool of jobs and Sailors will be "*closed*" in Q_3 for the slating process to occur; i.e. no new Sailors or jobs will be added or deleted (within reason, of course)

SECTION 3

Detailed Discussion of Slating Requirements

This section defines the criteria by which Sailors could be slated. These slating requirements, as they relate to requisition development, are not to be confused with requirements for the slating functionality, which is desired in the detailer/assignment piece of the Sea Warrior Career Management System (SWCMS). That is, slating by these particular criteria is part of the ROTWIN business process; the development of the requisition is not concerned with the *mechanism* for slating Sailors to jobs, but providing a requisition with the *information* necessary for slating to occur. Most of the required information derived from these criteria are listed in Section 5. Any requirements drawn from these slating criteria should specifically address the development of the requisition such that it supports the business process outlined in the ROTWIN concept.

Below are listed the core measures of effectiveness (MOEs), or slating criteria, that have been identified in the ROTWIN project. They are slightly modified from the original criteria identified, but they fully represent the original criteria.

- **COSTS ASSOCIATED WITH THE ASSIGNMENT** - This may include PCS costs, training costs, Assignment Incentive Pay (AIP), and other factors that come into consideration when assigning Sailors to jobs. These costs need to be separated, at least by the three categories listed here.

- **SKILL MATCHING** - This is pretty generic. Could include any Skill Object, NEC, or special qualifications attached to the requisition. At our first meeting to develop requisition requirements, we discussed the possibility of utilizing PS8's "job fitness" capability for comparing Sailors to jobs as a measure of Sailor-job fitness. This is still a possibility, but regardless of exactly how the skill matching and optimization is done, the individual SOs, NECs, qualifications, and certifications must be attached to the requisition.

- **REQUISITION PRIORITY** - In the ROTWIN, optimizing the percentage of "high-priority" fills is accomplished by only considering the highest priority jobs in the slating process. The MCAs are the owners of the prioritization algorithms, and would be the primary provider of requirements for requisition development. There has been some preliminary research done pertaining to a demand-driven requisition system based on the billet file. The project is called **Distribution 2000 (D2K)**, and the POC is **Janet Spoonamore, DSN 882-2491**. This prototype has been evaluated and critiqued by the MCAs (documented), and it has been used in conjunction with PeopleSoft in the first demo of Sea Warrior in November, 2002. Currently, D2K is a limited prototype, but being a web-based tool, there is likely much to be learned and reused from D2K with regard to demand-driven distribution. As the owners of the requisition, the MCAs must give concurrence to any proposed methodology for producing the requisition.

- **GAP/OVERLAP** - I use this vice the On-Time arrival MOE, since it opens up the problem space a little more to allow for more possible solutions. In terms of requirements for the requisition, it would be the same.

- **MEETING DUTY PREFERENCES** - In the proposed SWCMS, it is envisioned that the applications and/or bids themselves would be the indication of preference, i.e. preference for a particular billet. Things like specific type of duty, platform, and location could be optimized as well. I think that the intelligent agent piece (Sailor Preference Wizard) is working to get at that issue, at least for the Sailor-searching-jobs arena.

SECTION 4

MCA Eligibility/Screening Criteria Concerns

Many problems related to distribution, especially in a slating scenario, stem from a Sailor's ineligibility for a job that he has either applied for or has received orders to. If the Sailor has only applied for a job for which he is ineligible, then he has only wasted the detailer's time in having to check his eligibility and respond to the Sailor to tell him that he is ineligible. It's not that this is a minor issue (analysis has shown that there are about as many invalid applications as there are valid ones), but the latter problem is much greater in terms of its time consumption and consequences. For example, suppose that there is a highly sought after job in the UK, a one-of-a-kind. A Sailor gets assigned to the job, and then a couple of months later he fails his overseas screening. The job goes back on the requisition list, and the eligible Sailors that applied at the same time as the ineligible Sailor are already under orders to other jobs. This could potentially create a certain level of heartburn with those Sailors, not to mention the time and trouble of issuing orders and undoing them.

The MCAs and others believe that many problems related to eligibility could be avoided by pre-screening measures taken before a Sailor applies for jobs. The objective of this section is to bring to light some concerns about eligibility screening. The requirements for the requisition that would be generated from these concerns are not immediately clear, since much of the screening process is executed in distribution vice allocation. However, regardless of how the screening is accomplished, it is highly likely that it would require certain data elements be identified with the requisition to make screening possible. These data elements are listed in **SECTION 5**, along with the slating data elements. Below is a list of eligibility concerns expressed by the MCAs and others in the ROTWIN working group:

- NJP (Non-Judicial Punishment)
- EFM (Exceptional Family Member)
- PRT (Physical Readiness Test)
- Number of dependents, primary and secondary (tends to be a problem for overseas)
- Security Clearance
- Valid Driver's License (recruiting and physical security)
- Sex (if requisitions are directly linked to positions, some positions are directly linked to a female rack on a ship…)

SECTION 5

DATA ELEMENTS REQUIRED FOR THE ROTWIN
(non-exhaustive list)

The following is list of data elements that have been identified as necessary to screen Sailors for eligibility, evaluate slating MOEs, and allow Sailors to search requisitions that meet their preferences via the preference wizard. This list is by no means exhaustive, but should serve as a good initial data model for the ROTWIN requisition requirements.

DATA ELEMENT/INFORMATION	**SLATE**	**SCREEN**	**PREFS**
UIC (Unit Identification Code)	**X**		
UIC Short Title	**X**		**X**
Rating	**X**		**X**
Paygrade	**X**		**X**
RCN (Rating Control Number)	**X**		**X**
NEC1 (Primary Required Navy Enlisted Classification)*	**X**		
NEC2 (Secondary Required Navy Enlisted Classification)*	**X**		
TUM (Take Up Month)	**X**		
ATC (Area Type Code)	**X**		**X**
Requisition Priority	**X**		
FAC (Functional Area Code)	**X**		
Type of Platform	**X**		**X**
Skill Objects, special certifications, special qualifications, etc.	**X**		**X**
Assignment Incentive Pay MAX allowable bid	**X**		
MCA	**X**		
Valid Driver's License Requirement		**X**	
Particular Sex (M/F)Required		**X**	
Citizenship Restrictions	**X**	**X**	
Security Clearance Requirement		**X**	
Prospective Location	**X**	**X**	**X**

* It is understood that some codes or names for data elements will either be going away or changing, but NEC should always be attached to a requisition if there has been one identified at the position level.

Endnotes

[1]Advancement Cycle refers to the time of year when Sailors test for advancement to the next rank. Normally advancement cycles occur twice per year. If a Sailor is promoted to the next rank, his fitness for filling jobs changes.

[2] If PRD precedes EAOS by a few months then the Sailor may use this difference as a negotiation tool. For instance, he may be able to extend at his current duty station until his EAOS, at which point he leaves the service. Thus the projection algorithm, which keys off of PRD, forecasts a job opening several months prior to it actually opening. The opposite is true if EAOS precedes PRD by a few months. If PRD and EAOS were always equal, then this source of forecast error would be eliminated.

3 The Navy Enlisted Classification (NEC) codes identify a skill possessed by the Sailor, yet not possessed by everyone in his rating. An NEC codes specifies a skill, knowledge, aptitude, or qualification that must be documented to properly manage billet/personnel fit.

[4] The "Khaki Barrier" separates enlisted Sailors who are at the rank of E-7 and above and those who are below. Normal Navy business rules allow jobs to be filled by Sailors within one rank of the billet description (i.e. an E-4 job could be filled by an E-3, E-4, or E-5 Sailor). Jobs for E-7 Sailors tend to be ones that are supervisory in nature, so it is rare to assign that Sailors below the rank of E-7 are assigned to E-7 or above designated jobs. Similarly, senior enlisted personnel, E-7 and above, are not assigned to jobs designated for junior enlisted. The term "Khaki Barrier" itself is derived from the fact that enlisted Sailors of rank E-7 and above are allowed to wear khaki colored uniforms.

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